CONFIDENTIAL

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MEMO CONCERNING THE USE OF THE 231-D TRANSMITTER FOR SINGLE SIDEBAND OPERATION

INTRODUCTION

This memorandum describes briefly the possibilities of using the 231-D transmitter for single sideband operation. There are generally two methods for accomplishing this objective. The transmitter can be modified rather extensively to be used in conjunction with a low power SSB exciter. On the other hand, the transmitter can be used with minor modification in conjunction with other equipment to produce SSB emission through the use of a combination of amplitude and phase modulation. The capabilities and limitations of each of these methods is described below.

CAPABILITIES AND LIMITATIONS OF THE 231-D

Capabilities

(a) Modification of 231-D for linear operation with a SSB exciter.

The 231-D transmitter was designed to operate as a plate modulated AM transmitter. Each of the radio frequency stages in this transmitter is designed for class C operation. The last two stages, namely, the intermediate power amplifier (IPA) and the final amplifier (PA) are used on all bands without frequency multiplication. It would be possible to modify these two stages to operate as class AB1 or AB2 linear amplifiers. In this case, an external SSB exciter with approximately five watts output could be used to drive the 231-D to a peak envelope power output from 1000 to 2000 watts.

(b) Use of 231-D with the hybrid modulation system for SSB operation.

In the Proc. IRE, July 1952, a method is described for producing SSB emission from a standard AM transmitter by the use of a combination of amplitude and phase modulation. This system of modulation belongs

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to a family of modulation methods known as "hybrid modulation." Since that time, this method of SSB generation has proved to be practical provided the AM transmitter meets certain requirements. This system has a number of advantages when one proposes to use a standard AM transmitter to produce SSB emission. The principal advantage is that very little modification of the AM transmitter is required.

A preliminary study of the published characteristics of the 231-D transmitter indicates that this transmitter might be suitable for use with the hybrid modulation system. Briefly, the characteristics required of the AM transmitter concern the modulator amplitude and phase versus frequency characteristics. The specifications for the 231-D transmitter indicate an audio frequency bandpass from 150-3500 cycles. However, audio frequency response test data contained in the instruction book indicate that the high frequency response is down only 0.3 db at 5000 cycles. Assuming this to be the high frequency response, the 231-D might produce SSB emission for audio modulating frequencies having a bandwidth of 2500 cycles, with unwanted sideband suppression of approximately 25 db. The unwanted sideband can be further suppressed by limiting the bandwidth of the modulating signal or by improving the high frequency response of the 231-D modulator.

One of the principal advantages of the hybrid modulation system when used with the 231-D is that all of the autotune features would be unchanged. Likewise, the servo tuning features recently incorporated into the 231-D by [redacted] could be retained under certain conditions. 25X1

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Limitations

When the 231-D transmitter has been modified for linear operation of the IPA and PA stages, the transmitter can still be operated as an AM transmitter with lower carrier output power. If no changes in the operating conditions of these two stages are made upon return to AM operation, the carrier output power would be approximately 500 watts. A more detailed study might indicate the possibility of changing the operating points of these two stages in AM service in a rather simple manner to provide substantially more carrier power.

The principal limitation of the hybrid modulation system is that the frequency responses of the audio equipment, including the modulator, of the associated AM transmitter must be two to three times as great as the bandwidth of the modulating signal to be used in SSB service.

RECOMMENDATIONS

In view of the considerations enumerated above, the following recommendations are submitted:

1. The feasibility of using the hybrid modulation method of SSB operation of the 231-D transmitter should be explored further. The following engineering approach is recommended for this purpose.

   (a) Obtain test data of the 231-D modulator characteristic in the 25X1

   (b) These characteristics should be examined to determine the performance of the 231-D when operated with the proposed system.

   (c) Provided the results of (a) and (b) above are satisfactory, suitable auxiliary equipment should be obtained or constructed and used for a system test and evaluation in the . 25X1

2. Modification of the 231-D transmitter for use with an external

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SSB exciter should be investigated further. This study would take into account the limitations of the transmitter under both modes of operation.

3. The relative advantages of the methods proposed in 1 and 2 above should be compared. This study would furnish the basis for selecting either one or the other method.

Respectfully submitted,

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By [redacted] 25X1

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